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ABSTRACT

This study investigated the effect of cognitive style on continuing education of scientists and engineers and the interaction of cognitive style with motivation for and inhibition of continuing education. The Group Embedded Figures Test for field dependence/independence, Adult Nowicki-Strickland Internal-External Scale for locus of control, and a continuing education assessment scale (drawn from Boshier's Educational Participation Scale) to collect individual demographic/experiential data were administered to 350 employed engineers and scientists in 19 organizations. Results indicated that: (1) scientists/engineers are significantly more field independent than the general population, tending to confirm characteristics thought to be associated with the field independent personality (more analytical and less social); (2) field dependence/independence interacted with educational structure variables to affect outcomes, suggesting a need for more interaction among field dependent personalities, who like non-lecture classes, and a lack of tolerance for seminars among the highly field independent; (3) "advancement" and "knowledge" are more important than "satisfying requirements" or "diversion" as motivators, the major blocks to continuing education being time and course availability; (4) recitations and seminars are preferred (even by field independent subjects) over lectures; and (5) university courses are regarded as poorer than those sponsored by employers and professional associations. Implications based on these findings are discussed. (Author/JN)

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COGNITIVE STYLE AND MOTIVATION IN CONTINUING EDUCATION

FINAL REPORT

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Division of Science Education And Research
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April 15, 1982

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Gentlemen:

This is the Final Technical Report, "Cognitive Style and Motivation in Continuing Education" submitted under NSF Grant SED-7919945. We appreciate having had the opportunity to carry out this research and believe it will make a contribution to the increasing knowledge base about cognitive style and continuing education for scientists and engineers.

Sincerely,

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ABSTRACT

This study was designed to investigate the effect of cognitive style on continuing education of scientists and engineers and to explore the interaction of cognitive style with motivation for and inhibitors of continuing education.

The methodology involved the administration of 3 instruments to a sample of 350 employed engineers and scientists in 19 organizations. The instruments included (1) the Group Embedded Figures Test for Field-dependence-independence, (2) The Adult Nowicki-Strickland-Internal-External Scale for Locus of Control and (3) The Continuing Education Assessment developed by the author to collect individual demographic and experiential data. It draws from Boshier's Educational Participation Scale.

The results tend to confirm early work by the author with undergraduates, graduates and continuing education students in a single university. Engineers and scientists are significantly more field-independent than the general population. The hypothesis that field independence would interact with educational structure variables to affect outcomes was again supported. Field dependent persons have less tolerance for lectures.

In general, even with an overall highly field independent population, it is clear that interactive learning experiences (recitations and seminars) are preferred over less interactive experiences (lectures and correspondence courses).

With respect to motivation, "advancement" and "gaining knowledge" are more important than "satisfying requirments" or "diversion" as motivators. Lack of time is seen as the most important inhibitor (as opposed to cost or availability of courses, for example).

University courses are regarded by continuing education students as poorer than those sponsored by employers and associations. Although over two-thirds of those sampled would recommend the courses they took, fully 30% would not, suggesting considerable dissatisfaction with the available continuing education system.

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I INTRODUCTION

1.1 RESEARCH OBJECTIVE

This report describes a research effort designed to develop a more in-depth understanding of the learning styles, attitudes, and motivations of graduate engineers and scientists. While it is clear that many things affect the demand for continuing education, this study focuses on certain specific behavioral characteristics of the individual in an attempt to relate cognitive style and motivation to the utilization of, and satisfaction with, continuing education.

It is clearly not possible to simultaneously explore all of the interactions of all of the important variables, but it is possible to identify the major effects of learning style, attidues and motivation on the likelihood of enrollment in continuing education for scientists and engineers.

The objective of this study, put concisely, is to show that adult learning styles and attitudes may be an important explanatory variable in predicting the demand for and utilization of continuing education.

1.2 BACKGROUND

1.2.1 DEFICIENCIES IN KNOWLEDGE

Most of the research in continuing education — with a few special exceptions related to demand — have concentrated on the socio-economic, demographic and system variables. Some small amount of research has been done on the motivation toward continuing education. Almost nothing has been done on how learning patterns (cognitive styles) affect motivation, likelihood of utilization, and success in continuing education.

While the research base in cognitive style is still small, there is increasing evidence that this may be a very important factor in determining educational outcomes, and both NSF and NIE have paid increasing attention to this area.

Thus the major deficiency in knowledge has been perceived as the effect of cognitive style and learning attitudes as they impinge on the motivation to utilize continuing education; and this, therefore, has been the target of this research effort. The significance of how this knowledge can be utilized in policy-making, and how it might affect future research, is discussed in Section 1.3, but first it is important to discuss the existing knowledge base and references.

1.2.2 THE EXISTING KNOWLEDGE BASE

We identify very briefly below the important knowledge and research base that exists and that formed the basis for initiating this research project. Appendix II contains an in-depth elaborate discussion of some of the theoretical background for this study, while Appendix III contains a complete bibliography for all works referenced.

To begin with, perhaps the broadest and most authoritative demographic data on continuing education is contained in the Participation in Adult Education (PAE), a trienial Series done for the National Center for Education Statistics (NCES) by the Bureau of the Census, and authored by Boz3 (1978). This survey and analyzis, although not limited to scientists and engineers, provides excellent data on the demographic characteristics of participants and non-participants in continuing education. It also provides some rudimentary motivational data, i.e. "reason for taking course."

Also of importance and directly related, in that they deal in either the demographics or demand and motivation for continuing education, are several recent studies conducted under the sponsorship of NSF. The first is "A Survey of Continuing Education for Non-Academic Scientists and Engineers Provided by Industry and Government", by Levy (1979), which is a national survey assessing magnitude, participation, organizational support, and motivation and satisfaction. A parallel study by Welling (1980) develops a needs assessment for small, geographically-dispersed units.

Also of interest is the work by Snow (1980), on relating organizational atmosphere and practice to the motivation of engineering and scientific personnel to participate in continuing education, and the work of Farr relating individual motivation, work environment and continuing education. Finally, of primary relevance both methodologically and in terms of content, is our own past work, by Samers and Whitcup, on learning patterns and cognitive styles in continuing education.

Of methodological interest there are also a number of research efforts not funded by NSF but worthy of note. In the area of motivation there is the work on nursing continuing education done by Hammer (1977) which develops a model of adult interest, needs and motivation in continuing education. There are also some very interesting works on motivational orientation — both a critical review of the literature and the development of an education participation scale by Boshier (1976-1977) and a discussion of the implications of this work for program development, by Darkenwald (1967).

Two other related methodological studies include the development of a magnitude estimation scale for adult learning, by Blunt (1977), and a

more fundamental conceptualization of "learning how to learn", by Smith and Haverkamp (1977).

The area of cognitive style is, of course, central to the research effort and we include our own previously developed review in Appendix II. We briefly point out here that Messick (1970) has identified nine dimensions of cognitive style, the best known of which is field-independence versus field-dependence, and which has been extensively investigated by Witkin (1969 through 1976) and his associates. Work by McKenney (1974) and his associates on information gathering and evaluation, and by Hill (1971-74) and his co-workers on symbols, cultural determinants and modality of inference, is also important. Finally, work on Internal-External Locus of Control Scales by Rotter (1966) and Nowicki and Strickland (1973), is worthy of note.

Thus there is some relevant work both in motivation in continuing education and in cognitive styles. However, there is little empirical work which links the new findings and methodology in educational psychology (cognitive style) with motivation research in continuing education, and thus the impetus for this study.

1.3- SIGNIFICANCE

Darkenwald pointed out that continuing education should be designed on the basis of the needs and learning styles of adults. Boshier stated that his own work, utilizing the Educational Participation Scale (EPS) left many unanswered questions.

While there has been significant concentration on situational and systematic aspects of motivation, the interaction of learning styles of teachers and students (cognitive processes) has not been thoroughly explored.

In fact there has been very little work on the cognitive processes of continuing education students. Witkin pointed out in his review of learning and teaching styles that "Interestingly enough, the evidence available...comes almost entirely from studies in which the students were of elementary or high school age. Essentially no work has been done with students on the college or graduate school levels." He also pointed out that it is not farfetched to imagine that some day tests of learning style may equal, if not supplant, I.Q. tests as educational evaluation tools.

The interaction of cognitive style and motivation for continuing education is apt to be of even more importance for scientists and engineers. Our own preliminary research (Samers and Whitcup) showed that engineers are highly field-independent in their learning styles; and therefore may do better in learning situations geared to this cognitive style. It is clear that cognitive style as represented by field independence, is an important link in understanding the motivation of scientists and engineers to participate in additional continuing education.

Finally, this research is only a small step in understanding the relationship of cognitive processes to motivation in continuing education. The methodological approach used was a broad scale industrial survey using psychological instruments and student recall of continuing education experiences. The next step in future research might involve actual measurements of motivation and demand for continuing education under a controlled long-term experiment where various student learning styles and faculty teaching styles are selected and controlled.

2 METHODOLOGY

In this section of the report we discuss briefly the research protocol, how the sample was selected, what instruments were used and how they have developed, and what analyses were performed.

2.1 RESEARCH PROTOCOL

Briefly the research effort consisted of the following major steps:

(1) Specific delineation of the research objectives, the development of likely hypotheses, and the identification of data needs to support the hypotheses.

(2) Development and/or selection of instruments for collection of the data.

(3) Design of a sampling plan and mechanism for identifying organizations and individuals within organizations from whom the data would be collected.

(4) Selection of the sample.

(5) Recruitment of the organizations.

(6) Administration of the data collection instruments: (a) Group Embedded Figures Test, (b) Adult Nowicki-Strickland Internal-External Locus of Control Scale, and (c) Continuing Education Assessment (Cooper and Company).

(7) Manual editing, keying and verifying, computer editing and tabulation of the data.

(8) Analysis of the results to explore likely hypotheses identified in Task 1.

2.2 DESIGN AND SELECTION OF THE SAMPLE

Our original concept set a target of 2500 persons from 50 firms as the sample size. This turned out to be overly optimistic from the point of view of what was to be realistically achievable. We also expected to split the sample between Southern California and New England, in order to look at at least two widely dispersed geographic areas.

Initial response rates in New England were so poor, however, that new strategies had to be developed involving intensive follow-up which would not have been possible in Southern California, and so the sample was confined to the northeast, including New Jersey, New York, Connecticut, Rhode Island and Massachusetts.

The first sampling problem had to do with the size of the firm to be selected. It was initially decided that it would make little economic sense to try and sample firms with less than ten candidate employees (employees with at least a bachelor's degree in Science or Engineering). Based on this rule of thumb, it was decided that in order to find ten such professional/technical employees, a firm size of about 500 employees would be necessary. Utilizing this cut-off and Dun & Bradstreet Directories, a mailing list of all firms with 500 or more employees in the states of New Jersey, New York, Connecticut, Rhode Island and Massachusetts was compiled. This included approximately 400 firms and was supplemented by a list of 50 special laboratories obtained from Industrial Research Laboratories of the U.S.

The sampling universe could be thought of as all firms in four states of any size sufficient to employ at least 10 professional engineers

and scientists. It was later learned that the cutoff of 500 employees included many of the firms which did not employ even ten engineers or scientists. Other firms may have in aggregate employed that many, but not at their corporate headquarters, which were the listed addresses. This presented still another problem, since many organizations have multiple establishments and it was necessary to decide whether to contact each firm through its headquarters, or through an establishment level that would likely contain many scientific and technical employees (i.e., a technology center or corporate laboratory). In general, the contacts were made initially through the corporate headquarters, although in many cases ultimate research was carried out at a single specific location (usually a technology center).

After the initial letters had gone out it became readily apparent that intensive follow-up would be necessary to generate any kind of response. Every organization was therefore called at least once. (Many firms were called at least a half-dozen times). Some firms were also visited personally in order to encourage response. The final sample of 19 organizations who agreed to participate is described in Table 1 (without revealing actual names).

At each organization the recruitment of the sample of participating individuals was voluntary. This, of course, may cause some bias in the sample, although, for practical purposes, there was no way of overcoming this limitation. Neither we nor the participating organizations could compel employees to participate, and even if that were possible, the act of requiring employees to participate would in itself create certain biases. The number of volunteers at each organization is also listed in Table 1.

TABLE 1: TYPE AND SIZE OF ORGANIZATIONS IN SAMPLE

Type of Organization	Facility Visited	SIC's	Sales (millions)	Employees	Sample Size
Rubber Tire Manufacturer	Corp. Research & Engrg.	3011	377	5,650	22
Aeroframe & Aerospace Parts Mfg.	Corp. Research & Engrg.	3728, 3721, 3931	42	1,400	9
Pharmaceutical Manufacturer	Research Center	2834, 5122, 5191, 2099	270	3,000	40
Manufacturing Tools & Metal Parts Manufacturer	Div. Research & Engrg.	3559, 3452, 2891, 3429, 3585, 3714	1,190	33,000	13
Metal Parts Manufacturer	Corp. Res. & Engrg.	3461, 3542	73	1,960	7
Home Building Const. Mfg.	Div. Research Center	3261, 3442, 3743 3499, 2757	2,111	49,000	5
Electronic Equipment Mfg.	Corp. Research & Engrg.	3643, 3644, 3423	190	2,750	16
Electrical Equipment Mfg.	Corp. Research & Engrg.	3612, 3649	39	1,250	18
Aerospace & Systems Lab. Equip.	Div. Tech. Center	3662, 3832, 3829	50	1,400	27
Household Products Mfg.	Corp. Research & Engrg.	2844, 2211, 3842, 2099	4,300	56,600	22
Medical & Electronic Equip. Manufacturing	Corp. Research & Engrg.	3841, 2931, 3079, 2381, 3679	682	17,700	19
University Laboratory	Laboratory	8922	6	125	9
Systems Analysis & Electronics Laboratory	Corporate Lab.	7391	N/A	1,750	6

TABLE 1: TYPE AND SIZE OF ORGANIZATIONS IN SAMPLE (continued)

Type of Organization	Facility Visited	SIC's	Sales (millions)	Employees	Sample Size
Primary Metals Refiners & Mfg. of Raw Metals	Res. & Engrg. Center and Mfg. Facility	3533, 1389, 2816, 2894	2,000	24,700	28
Chemical & Pharmaceutical Manufacturing	Pharmaceutical Div. Technology & Mfg. Center	2833, 2834, 2879, 2869, 2944, 3079	2,746	43,963	33
Chemical Manufacturing	Corp. Research & Engrg. Center	2819, 2879, 2869, 2812, 2821, 3079	1,526	12,300	17
Systems Analysis & Electronics Laboratory	Corporate Laboratory	8911	123	3,450	25
Software Systems Analysis Developer	Corporate Staff	7372	5	100	8
Chemical & Metal Products Manufacturing	Research & Technology Center	2819, 2899, 3331, 2821, 3484, 3949	1,778	23,000	28

The nineteen organizations in the sample vary in size from 100 employees to 50,000, with the median having about 6,000 employees. They cover a wide range of manufacturing and technical organizations, including an aerospace manufacturer, a tire manufacturer, 2 pharmaceutical manufacturers, a household products manufacturer, two metal parts manufacturers,, a basic metals producer, two chemical manufacturers, a university laboratory, 2 non-profit systems analysis "laboratories", a computer software house, and 3 electronics and electrical equipment manufacturers. Sales of these organizations ranged from just under 5 million to 4 billion.

Employees were in general recruited by circulating a letter or announcement about the study and asking them to volunteer. The information provided in the announcement promised confidentiality, but suggested they would also get back their own results. No attempt was made to encourage or discourage participants on the basis of continuing education experience. The invitation was open to all employees with a degree in science and engineering (and in a few cases others, as long as they were accorded professional status by their employers). Technical management employees were also invited to participate, and the mix of employees in most of the companies included a wide range of ages and responsibilities, although we must point out that no attempt was made to "control" the sample so that in any individual organization it was truly representative of the organization. Further, data was not available and could not easily be obtained to ascertain whether or not they were representative.

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*The problem of defining "representative" is a complex conceptual task, since it is not clear on an *a priori* basis what variables might have been considered, nor how they should have been weighted. Age, responsibility and education are likely candidates, but there are obviously also others, and the specific model appropriate to this research is not at all clear.

2.3 DESIGN AND SELECTION OF THE INSTRUMENTS

Three instruments were utilized in this study. The first two are well-documented in the literature of educational psychology, and were merely "selected" for use in this study.

They are the Group Embedded Figures Test (GEFT) for field independence (Witkin, et al) and the Adult Nowicki-Strickland Internal-External Scale for locus of control (ANSIE), (Nowicki-Strickland).

The former test, the GEFT, is a well-documented test which we have used before, distributed by the Consulting Psychologists' Press. A description of the test is provided in Appendix I. This is probably the most widely used group test for any aspect of cognitive style. It is designed to measure field independence.

The second test is one of many available for measuring locus of control. In previous research we have utilized the Rotter Scale, which is probably the most well-known and frequently used of such tests. It has come under criticism primarily because, like most tests in this area, the questions are often correlated with social acceptability. In any case, we did not get strong results with our previous use of the Rotter Scale, and as a result of several recommendations, switched in this research to the ANSIE scale. A description of the test can also be found in Appendix I. (The actual instrument is available from Professor Nowicki, at Emery University, as described in Appendix I). This test was derived from an earlier one designed for children, and in our own opinion and that of many of the adults tested, there are a number of items in the test which are still not adequately adapted for adults.

The third instrument was one of our own design, whose object was to capture the demographic background and continuing education experiences of the individuals. This instrument is also shown in Appendix I. The initial part of the instrument deals largely with factual background material. It also addresses the issue of preferences in educational style and asks for other various assessments of the participants' experiences in continuing education. The instrument also explores motivations for and blocks or inhibitions to, continuing education. For this is draws heavily on the work of Boshier, whose Educational Participation Scale provides a typology for classifying motivational orientation. Boshier's early work (1971) made use of factor analysis, and developed 14 factors describing the participants' motivational orientation to adult education. In later work (1977) he collapsed these into six factors, which were used in our own instrument. The six "factors" we employed contain many of the same words Boshier utilized in his own 47 individual items, facilitating understanding of the general concept by the respondent. The six factors correspond to social relationship, escape/stimulate, professional advancement, social welfare, cognitive interest, and external orientation.

The instrument also deals with blocks or inhibitors to continuing education and here we utilize five factors which we believe cover the major reasons typically identified in the literature as inhibitors of continuing education.

Both the motivating and inhibiting factors were designed to be completed with a two-part response: first a yes or a no, as to whether the factor *applied* to the respondent, and then a second yes or no as to whether the factor was *critical* to the respondent. This "second" weighting or

or review was specifically utilized to reduce social acceptability, or other undesirable responses resulting from boredom, etc., by implicitly asking the respondent, "Is the answer you've given really important to you?"

2.4 ANALYSIS

The fundamental hypotheses to be tested in the results are

(1) That cognitive style (field independence) and locus of control affect educational outcomes differentially, depending on educational design variables and motivation.

(2) That there is a relationship between motivation, cognitive style and the perceived educational experiences.

Other areas of interest include

(1) The variability of cognitive style and locus of control with demographic and job-related variables.

(2) The effect of cognitive style on students' course selection processes.

The analysis of the data was accomplished using SPSS. This system makes it very easy to program and carry out multiple analyses, and we have taken advantage of this facility. Unfortunately, the tendency to carry out wide-ranging and exploratory analysis rather than to stick to a few originally posited hypotheses leads to voluminous results, most of which cannot be presented in a reasonably-sized report.

The analysis plan called for the following:

(1) Simple one-way frequency distributions for all variables.

(2) Cross tabulations (with X^2 or other suitable tests) comparing educational outcome variables (e.g., recommend course) with GEFT, ANSIE, and motivational variables.

(3) Two-way analyses — comparing educational outcome variables with the interaction of GEFT, ANSIE, motivational variables and educational design variables (e.g., type of course).

(4) Analysis by company (not presented in this volume but furnished to each of the companies).

These results are presented in Section 3, which follows.

3 RESULTS

The presentation of results begins with the most general findings (descriptions of the characteristics of the participants and their educational experiences and reactions), then proceeds to the more specific, including the investigation of hypotheses (interactions of Field Independence and Locus of Control with motivation and experiences in continuing education) and finally concludes with a summary which identifies what we believe to be the key findings.

The analysis carried out involved some 600 pages of tables and it is simply not possible to present all of the results. For the most part we have presented only positive results, summarizing those areas where hypotheses about relationships were not confirmed, but even then considerable editing has taken place. One danger when a large number of analyses and tests are carried out is that certain relationships will appear significant just out of chance. To reduce the likelihood of this we have adopted a rather tight significance level (.05) as a general screen, although where it seems appropriate because of interest in the specific variable we present the actual significance level (whatever it is).

Finally, we should point out that this research effort is only one small additional step toward understanding the importance of cognitive style as it effects continuing education. It confirms certain aspects of previous work and leaves others in question. For some hypotheses the weight of evidence is mounting and this study may prove definitive. For others the study merely does what most research does — it helps to crystalize the unsolved problems.

3.1 GENERAL RESULTS DESCRIBING THE STUDY PARTICIPANTS AND THEIR EDUCATIONAL EXPERIENCES, MOTIVATION AND COGNITIVE STYLE

3.1.1 CHARACTERISTICS OF THE PARTICIPANTS

The key demographic, work and educational characteristics of the participants are presented in Tables 2 to 15, and discussed below.

- The primary fields of work of the participants are well distributed through science and engineering with physical science and mechanical engineering being the most important, but far from dominant.
- Work activity is also scattered, although 46% described themselves as being in management and administration, reflecting a strong participation by more responsible individuals. It should be noted, however, that they still described their field of work as science or engineering and were so regarded by their organizations, or would not have been invited to participate.
- The age distribution reflects no unusual information. A diverse distribution with modal value in the 30 to 39 group.
- About 12% of the sample involved females, which is not unusually low for the population being sampled.
- Minority representation in the sample was small and below that of national averages.
- Approximately 40% of the participants had supervisory responsibility, so that some who claimed their field was management and administration may have had staff assignments without supervisory

responsibility.

- In terms of experience the participants were quite mature, with 75% having more than 5 years of experience and over 35% having more than 20 years.

- Slightly over 40% of the participants held advanced degrees, and slightly over 10%, doctorates. The fields of their degrees paralleled their work areas, both in diversity and in the areas of concentration.

- Years since last degree reflected the age of the population with just over 65% at least 10 years out and just over 50% at least 20 years out.

- In terms of expressed subject preferences they liked engineering and science most, and language and social science least — not unsurprisingly.

- In terms of type of class, however, they showed strong general preference for recitations and seminars over lectures and correspondence courses, which is slightly contradictory to what might have been expected for a "high GEFT - analytical" population. This will be explored in more depth as we attempt to look at more detailed interactions.

TABLE 2: PRIMARY FIELD OF WORK

	Frequency	Percent
Mathematical Science	5	1.4
Physical Science	85	24.6
Computer Science	24	6.9
Life Science	22	6.3
Environmental Science	4	1.1
Other Science	16	4.6
Mechanical Engineering	61	17.6
Civil Engineering	2	.6
Electrical Engineering	34	9.7
Chemical Engineering	33	9.5
Industrial Engineering	5	1.4
Aeronautical Engineering	2	.6
Other Engineering	37	10.6
None of the above	18	5.2
No answer	4	-
	352	100.0

TABLE 3: PRIMARY WORK ACTIVITY

	Frequency	Percent
Basic Research	40	11.4
Applied Research or Development	30	8.5
Management of R&D	32	9.1
Production Engineering	6	1.7
Management and Administration	164	46.6
Consulting	34	9.7
Customer Services	15	4.3
Sales	1	.3
Other	30	8.5
	352	100.0

TABLE 4: AGE

	Frequency	Percent
20 to 29	88	25.5
30 to 39	115	33.3
40 to 49	66	19.1
50 to 59	65	18.8
60 or over	11	3.2
No answer	7	-
	352	100.0

TABLE 5: SEX

	Frequency	Percent
Male	302	88.3
Female	40	11.7
No answer	10	-
	352	100.0

TABLE 6: RACE

	Frequency	Percent
White	321	91.7
Black	8	2.3
Hispanic	7	2.0
Asian	14	4.0
No answer	2	-
	352	100.0

TABLE 7: SUPERVISORY RESPONSIBILITY

	Frequency	Percent
Yes	140	40.5
No	205	59.2
No answer	7	-
	352	100.0

TABLE 8: YEARS WORKED AS ENGINEER OR SCIENTIST

	Frequency	Percent
2 or less years	42	12.4
3 to 5 years	47	13.9
6 to 10 years	69	20.4
11 to 20 years	85	25.1
More than 20 years	95	28.1
No answer	14	-
	352	100.0

TABLE 9: HIGHEST DEGREE

	Frequency	Percent
Bachelor's	165	47.1
Masters	122	34.9
Doctorate	39	11.1
Other (Primarily Associate)	9	2.6
None	15	4.3
No answer	2	-
	352	100.0

TABLE 10: SPECIAL FIELD OF DEGREE

	Frequency	Percent
Mathematical Science	17	5.0
Physical Science	78	23.2
Computer Science	7	2.1
Life Science	22	6.5
Environmental Science	5	1.5
Other Science	13	3.8
Mechanical Engineering	64	19.0
Civil Engineering	2	.6
Electrical Engineering	33	9.8
Chemical Engineering	51	15.2
Industrial Engineering	5	1.5
Aeronautical Engineering	6	1.8
Other Engineering	12	3.6
None of the Above	22	6.5
No answer	15	-
	352	100.0

TABLE 11: YEARS SINCE HIGHEST DEGREE

	Frequency	Percent
3 or less years	24	6.9
3 to 5 years	41	11.8
6 to 10 years	48	13.8
11 to 20 years	56	16.1
More than 20 years	178	51.3
No answer	5	-
	352	100.0

TABLE 12: SUBJECT LIKED

	Frequency	Percent
Mathematical Science	60	17.2
Physical, Life, Environmental Science	119	34.2
Social Science	7	2.0
Business	10	2.9
Engineering	134	38.5
Fine Arts	3	.9
Language Arts	5	1.4
Other	10	2.9
No answer	4	-
	352	100.0

TABLE 13: SUBJECT DISLIKED

	Frequency	Percent
Mathematical Science	33	9.6
Physical, Life, Environmental Science	9	2.6
Social Science	68	19.9
Business	33	9.6
Engineering	17	4.9
Fine Arts	55	16.0
Language Arts	108	31.4
Other	21	6.1
No answer	8	-
	352	100.0

TABLE 14: TYPE OF CLASS PREFERRED MOST

	Frequency	Percent
Lecture	54	15.4
Recitation	110	31.4
Seminar	86	24.6
Lab	74	21.1
Tutorial	18	5.1
Correspondence	8	2.3
No answer	2	-
	352	100.0

TABLE 15: TYPE OF CLASS PREFERRED LEAST

	Frequency	Percent
Lecture	94	27.4
Recitation	26	7.6
Seminar	20	5.8
Laboraotry	13	3.8
Tutorial	40	11.7
Correspondence	150	43.7
No answer	9	-
	352	100.0

3.1.2 PARTICIPATION IN CONTINUING EDUCATION AND PARTICIPANTS' EVALUATION

Data on participation in continuing education courses, characteristics and evaluation of the courses are presented in Tables 16 to 31, and discussed below.

- Almost 75% of the participants had taken courses in the past two years (participation in continuing education activities was not a requirement for participation in the study). 50% of the participants had taken more than one course.

- With respect to course intensity, 40% took what appeared to be full semester courses. 30% participated in courses lasting less than one week. 60% of the courses involved more than 20 course hours, and only 20% were less than 10 hours.

- Only 50% of the courses were conducted by traditional educational institutions. Almost 16% were conducted by employers.

- Subject matter, by and large, paralleled the education work activity and interests of participants, with two notable exceptions — business and mathematical sciences — both of which exhibited higher levels than might have been expected from participants' backgrounds.

- With respect to the types of courses taken and expressed likes and dislikes, a serious mismatch is apparent. Over 30% of the courses were described as lectures — the modal characterization. This was also the course type disliked more than any other. Labs, which were among the highly preferred, were hardly exper-

ienced — less than 4%.

- On the subject of interaction with instructors and students, the results, on the whole, seem to suggest that there is substantial interaction, but in about 25% of the courses such interaction was insufficient — not a surprising finding — given that 35% of the courses were characterized as lectures.

- With respect to outcome variables, the courses got slightly better than average ratings on how well the course was organized, how much was learned, and how much the course was enjoyed. Over 96% of the courses taken were completed. Finally, 77% of the courses and 71% of the instructors were recommended. These latter two are perhaps the most important outcome variables, and while at first glance one may perceive these as highly favorable, a 25 to 30 percent non-recommendation rate seems high and is worthy of further analysis.

TABLE 16: TOOK COURSES IN PAST 2 YEARS

	Frequency	Percent
Yes	257	74.5
No	88	25.5
No answer	7	-
	352	100.0

TABLE 17: NUMBER OF COURSES TAKEN

	Frequency	Percent
None	88	26.5
1	69	20.8
2	70	21.0
3-5	79	23.8
5-8	26	7.8
No answer	20	-
	352	100.0

TABLE 18: DURATION OF COURSE

	Frequency	Percent
1 week	170	31.3
2 weeks	29	5.3
3 to 5 weeks	39	7.2
6 to 9 weeks	80	14.7
10 to 16 weeks	207	38.1
More than 16 weeks	19	3.5
	544*	100.0

TABLE 19: HOURS PER WEEK

	Frequency	Percent
1 hour	17	3.2
2 hours	89	16.7
3 hours	168	31.5
4 hours	40	7.5
5 hours	15	2.8
6 to 9 hours	87	16.3
10 to 20 hours	57	10.7
More than 20 hours	61	11.4
	534	100.0

*Respondents were asked to describe the 3 most recent courses they had taken. Since 88 did not take any course, 69 took only one, and 70 took only 2, a maximum of 580 responses were possible out of 1052, and should be viewed as the base number in succeeding tables about courses taken.

TABLE 20: TOTAL COURSE HOURS

	Frequency	Percent
1 to 5 hours	21	4.8
6 to 10 hours	78	17.6
11 to 15 hours	28	6.3
16 to 20 hours	50	11.3
21 to 30 hours	86	19.5
31 to 40 hours	85	19.2
More than 40 hours	94	21.3
	442	100.0

TABLE 21: WHO CONDUCTED COURSES

	Frequency	Percent
College or University	289	50.4
Employer	102	17.8
Association	120	20.9
Other	62	10.8
	573	100.0%

TABLE 22: COURSE SUBJECT

	Frequency	Percent
Mathematical Science	113	20.5
Physical, Life, Environmental Sciences	87	15.8
Social Science	10	1.8
Business	109	19.7
Engineering	139	25.2
Fine Arts	2	.4
Other	92	16.7
	552	100.0

TABLE 23: TYPE OF COURSE TAKEN

	Frequency	Percent
Lecture	201	35.2
Recitation	191	33.5
Seminar	130	22.8
Lab	26	4.6
Tutorial	4	.7
Correspondence	7	1.2
Other	11	.9
	570	100.0

TABLE 24: INTERACTION

	WITH INSTRUCTOR		WITH STUDENT	
	Frequency	Percent	Frequency	Percent
Far less than average	44	7.9	65	11.7
Less than average	90	16.2	123	22.2
Average	226	40.6	205	36.9
More than average	133	23.9	114	20.5
Far more than average	66	11.3	48	8.6
	556	100.0	555	100.0

TABLE 25: WAS INTERACTION ENOUGH?

	WITH INSTRUCTOR		WITH STUDENT	
	Frequency	Percent	Frequency	Percent
Yes	391	72.7	391	76.5
No	147	27.3	120	23.5
	538	100.0	511	100.0

TABLE 26: HOW WELL WAS COURSE ORGANIZED?

	Frequency	Percent
Far less than average	45	7.9
Less than average	67	11.7
Average	195	34.1
More than average	197	34.1
Far more than average	70	12.2
	484	100.0

TABLE 27: HOW MUCH WAS LEARNED?

	Frequency	Percent
Far less than average	33	5.8
Less than average	69	12.1
Average	226	39.5
More than average	192	33.6
Far more than average	52	9.1
	484	100.0

TABLE 28: HOW MUCH WAS COURSE ENJOYED?

	Frequency	Percent
Far less than average	27	4.7
Less than average	83	14.6
Average	189	33.2
More than average	201	35.3
Far more than average	69	12.1
	487	100.0

TABLE 29: COMPLETED COURSE

	Frequency	Percent
Yes	541	96.3
No	21	3.7
	562	100.0

TABLE 30: RECOMMENDED COURSE

	Frequency	Percent
Yes	432	76.9
No	130	23.1
	562	100.0

TABLE 31: TAKE ANOTHER COURSE WITH INSTRUCTOR

	Frequency	Percent
Yes	367	70.7
No	152	29.3
	519	100.0

3.1.3 MOTIVATION AND INHIBITORS IN CONTINUING EDUCATION

In Tables 32 and 33 we represent some important data on respondents' attitudes towards continuing education, which are discussed below.

- Advancement, the desire to obtain knowledge and the need to comply with external requirements are clearly more important motivators than social, escape, or service needs. Over 90% of the participants named advancement as a motivating force.

- Time and the availability of courses were seen as the critical inhibitors or blocks to continuing education. Only 10% said they didn't need courses, but slightly over a third saw quality of the courses as a problem.

- While there appears to have been some confusion among participants as to when the critical column was to be completed, and the direction of the variable in the case of the motivation question, the patterns are fairly striking and easily facilitate analysis and understanding.

TABLE 32: REASONS OR MOTIVATION FOR TAKING COURSES*

	APPLIES		CRITICAL	
	Yes	No	Yes	No
Social	18.5 (65)	78.4 (276)	18.2 (16)	81.9 (72)
Requirements	66.5 (228)	33.5 (115)	45.7 (106)	54.3 (126)
Service	50.0 (168)	50.0 (168)	35.3 (60)	64.7 (110)
Advancement	95.6 (329)	4.4 (15)	52.6 (185)	40.3 (142)
Escape	29.9 (100)	69.8 (233)	24.6 (29)	75.4 (89)
Knowledge	80.4 (283)	18.2 (64)	48.2 (131)	51.8 (141)
Other	61.1 (22)	38.9 (14)	40.0 (8)	60.0 (12)

*Results are given in Percent Yes and No. Absolute Frequencies are given in parentheses.

TABLE 33: BLOCKS OR IMPEDIMENTS TO TAKING COURSES*

	APPLIES		CRITICAL	
	Yes	No	Yes	No
Time	69.1 (241)	30.9 (108)	80.0 (196)	20.0 (49)
Cost	36.2 (124)	63.8 (219)	69.4 (102)	30.6 (45)
Availability	57.7 (203)	39.2 (138)	83.5 (177)	16.5 (35)
Quality	36.0 (121)	64.0 (215)	77.5 (110)	22.5 (32)
Don't Need	10.7 (36)	89.3 (302)	41.5 (27)	58.5 (38)

*Results are given in Percent Yes and No. Absolute Frequencies are given in parentheses.

3.1.4 FIELD INDEPENDENCE AND LOCUS OF CONTROL

Data on the Group Embedded Figures Test (GEFT) and Adult Nowicki-Strickland Internal-External Scale (ANSIE) are shown in tables 34 to 37, and are discussed below.

- The Group Embedded Figures Tests show results very similar to those achieved by Samers and Whitcup in 1979, and suggest that those findings were not an isolated phenomenon. Namely, engineers and scientists obtain scores significantly higher than the average undergraduate population on Group Embedded Figures Tests, suggesting more field independent (analytic) cognitive styles. Over 40% of the participants achieved maximum scores.*

- The Locus of Control Scale showed no special differentiation for this sample. Results were almost identical to those achieved by Nowicki over several years.

- Of course the important hypotheses have to do with the interactions between Field Independence and Locus of Control and other variables, and these are explored further in the succeeding results.

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*From a purely methodological point of view, Whitkin's observation that truncation at the higher levels may occur, and that it may be appropriate for discriminating purposes, within a given population, to shorten the test time, is confirmed. The obvious problem with this is that comparison over a broad range of populations is inhibited.

TABLE 34: GROUP EMBEDDED FIGURES TEST

GEFT SCORE	FREQUENCY	PERCENT	CUMULATIVE PERCENT
1-4	9	2.6	2.6
5-6	7	2.0	4.6
7-8	15	4.3	8.9
9-10	21	6.0	14.9
11-12	28	8.0	22.9
13-14	45	12.8	35.7
15-16	79	22.5	58.2
17-18	147	41.9	100.0
No Test	1	-	-
	352	100.0	100.0

Median Value	15
Mean	14.6
S.D.	3.7

TABLE 35: GEFT COMPARISONS

- VALUES OBTAINED IN THIS STUDY:

  Mean = 14.6 - S.D. = 3.7

  (No significant difference between males and females, (N=351)

- WHITKIN'S DATA — LIBERAL ARTS COLLEGE STUDENTS

	Males	Females
N	155	242
Mean	12.0	10.8
S.D.	4.1	4.2

- SAMERS AND WHITCUP — ENGINEERING GRADUATES, UNDERGRADUATES, CONTINUING EDUCATION STUDENTS AND FACULTY

	Faculty	All Students	Undergrads	Graduates	Cont. Ed.
N	12	117	44	36	37
Mean	16.2	14.4	14.2	13.1	15.1
S.D.	2.4	3.8	4.0	4.3	3.0

TABLE 36: LOCUS OF CONTROL — ANSIE

ANSIE SCORE	FREQUENCY	PERCENT	CUMULATIVE %
1-3	17	4.8	4.8
4-5	66	18.8	23.6
6-7	89	25.3	48.9
8-9	57	16.2	65.1
10-11	51	14.5	79.5
12-13	34	9.7	89.2
14-15	23	6.5	95.7
16 or over	15	4.3	100.0
		100.0	100.0

MEDIAN VALUE	8
MEAN	8.5
S.D.	3.9

TABLE 37: ANSIE COMPARISONS

NOWICKI & DUKE (1973)

Mean	9.1
S.D.	3.9
N	154

DUKE & NOWICKI (1973)

	Males	Females
Mean	8.7	8.5
S.D.	3.5	3.4
N	22	26

NOWICKI & YOLY (1974)

Mean	8.9	8.3
S.D.	3.6	3.7
N	23	42

PAPPAS & NOWICKI (1975)

Mean	8.6	8.0
S.D.	3.4	3.7
N	39	37

VALUES OBTAINED IN THIS STUDY

Mean	8.5
S.D.	3.9
N	352

NOWICKI STUDIES COMBINED

Mean	8.7
S.D	3.7
N	343

3.2 SIGNIFICANT RESULTS RELATING TO THE IMPORTANT HYPOTHESES UNDERLYING THE STUDY

3.2.1 INTERACTIONS WITH FIELD INDEPENDENCE AS MEASURED BY GEFT

In Tables 38 to 42 significant results showing the interaction of field independence with demographic, educational outcome and motivational variables are presented. We discuss them briefly below.

- Although the conventional wisdom is that GEFT is independent of intelligence, some researchers have found links between GEFT and educational performance. Among the respondents sampled in this study we found a significant relationship between GEFT and undergraduate grade averages. More students with high GEFT scores had higher undergraduate grades than would be expected on the average. We suspect that this is not necessarily a function of intelligence, but has to do with the ability of the high GEFT personality to deal effectively with lecture type, low interaction classes which tend to predominate undergraduate education.

- In support of this, among respondents who were reporting on a recent course and who characterized it as a lecture, more of those with lower GEFTs were less willing to take another course with the same instructor. This finding parallels earlier results by Samers & Whitcup. In general, there seems to be a dislike of the lecture technique (despite its significant use), which is particularly a problem for persons with a field dependent cognitive style.

- An effect not previously detected shows up in two significant relationships between "GEFT scores" and "age," and "GEFT scores" and

"years since last degree." In general, more persons with higher GEFT scores occurred in the lower age groups and in the groups with fewer years since last degree. In previous research, faculty and continuing education students were found to have higher GEFT scores than undergraduates, an opposite result. The results here may be an artifact of the sampling process (i.e. self-selection among older individuals may have led to a preponderance of field dependent people in the higher age groups).

- Respondents with high GEFT scores were more likely to find poor quality of courses a critical block to pursuing continuing education. (Note: Quality was not the most serious of blocks across the sample.)

- Although not shown in tables 38 to 41, because the results were not significant at the .05 level, two results shown in Table 57 are worthy of note. First, more respondents with low GEFT scores found their interaction with other students was less sufficient than those with high GEFT scores (significance level .0505); 2nd, for respondents who recently took a seminar style course, those with high GEFT scores recommended the course less than those with low GEFT. Both of these results support the underlying theory on the importance of interaction to field dependent students, and its undesirability for field independent students.

TABLE 38: GEFT VS UNDERGRADUATE AVERAGE

Undergraduate Grade Average	GEFT SCORE 1-8	9-12	13-14	15-16	17-18	Total
A	6	10	7	13	42	78
	(19.4)	(20.8)	(15.9)	(17.1)	(29.6)	(22.9)
B	16	34	29	46	85	210
	(51.6)	(70.8)	(65.9)	(60.5)	(59.9)	(61.6)
C	9	4	8	17	15	53
	(29.0)	(8.4)	(18.2)	(22.3)	(10.5)	(15.5)
Total	31	48	44	76	142	341
	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)

* In Tables 38 to 56 the results shown are absolute numbers. Column percentages are shown in parentheses.

Significance Level: .0222

TABLE 39: GEFT VS TAKE ANOTHER COURSE WITH INSTRUCTOR, IF FIRST COURSE WAS LECTURE

Take Another Course	GEFT SCORE 1-10	11-14	15-18	Total
Yes	7 (53.8)	15 (93.7)	19 (61.2)	41 (68.3)
No	6 (46.2)	1 (6.3)	12 (38.8)	19 (31.7)
Total	13 (100.0)	16 (100.0)	31 (100.0)	60 (100.0)

Significance Level: .0374

TABLE 40: GEFT VS. AGE

Age	GEFT SCORE 1-8	9-12	13-14	15-16	17-18	Total
20-29	7	19	11	21	30	88
	(23.3)	(39.5)	(25.0)	(26.6)	(20.9)	(25.6)
30-39	7	9	12	31	55	114
	(23.3)	(18.8)	(27.3)	(39.2)	(38.5)	(33.1)
40-49	8	8	6	11	33	66
	(26.7)	(16.6)	(13.6)	(14.9)	(23.1)	(19.2)
50-59	5	9	12	16	23	65
	(16.7)	(18.8)	(27.3)	(20.3)	(16.1)	(18.9)
60 or over	3	3	3	0	2	11
	(10.0)	(6.3)	(6.8)	(0.0)	(1.4)	(3.2)
Total	30	48	44	79	143	344
	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)

Significance Level: .0005

TABLE 41: GEFT VS. YEARS SINCE LAST DEGREE

Years Since Last Degree	GEFT SCORE 1-8	9-12	13-14	15-16	17-18	Total
2 or less	0	4	6	1	13	24
	(0.0)	(8.2)	(13.6)	(1.3)	(9.0)	(6.9)
3 to 5 years	6	10	4	9	12	41
	(20.0)	(20.4)	(9.1)	(11.5)	(8.3)	(11.8)
6 to 10 years	4	5	6	14	19	48
	(13.3)	(10.2)	(13.6)	(17.9)	(13.1)	(13.9)
11 to 20 years	2	5	4	15	30	56
	(6.7)	(10.2)	(9.1)	(19.3)	(20.7)	(16.2)
More than 20 years	18	25	24	39	71	177
	(60.0)	(51.0)	(54.6)	(50.0)	(48.9)	(51.2)
Total	30	49	44	78	145	346
	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)

Significance Level: .0241

Table 42: GEFT VS. QUALITY BLOCK CRITICAL

Quality Block Critical	GEFT SCORES 1-8	9-12	13-14	15-16	17-18	Total
Yes	4 (50.0)	15 (68.2)	12 (80.0)	24 (75.0)	55 (84.6)	110 (77.5)
No	4 (50.0)	7 (31.8)	3 (20.0)	8 (25.0)	10 (15.4)	32 (22.5)
Total	8 (100.0)	22 (100.0)	15 (100.0)	32 (100.0)	65 (100.0)	142 (100.0)

Significance Level: .0381

3.2.2 INTERACTIONS WITH LOCUS OF CONTROL AS MEASURED BY ANSIE

In Tables 43 to 48 the interaction of "locus of control" with educational and motivational variables is explored for results significant at the .05 level. We discuss them below.

- Respondents with extreme ANSIE scores (very external or very internal) prefer lectures. Those with low ANSIE scores (very internal) prefer tutorials and labs more often than lectures, recitations or seminars.

- Taking courses in order to "escape" from their work or other aspects of their current existence is more common among those with high ANSIE scores (feel that they are controlled by external forces)--a not unsurprising finding. Taking courses for the sake of "knowledge" itself was more likely among those with low ANSIE scores, that is, those who felt internally motivated.

- Respondents who found "costs" a block to continuing education were more likely to have lower ANSIE scores (internal).

- Those who found "quality" of courses a block to continuing education were apt to have middle ANSIE scores. Or, stated alternatively, those with extreme locus of control were less sensitive to quality as an inhibitor.

- Those who did not think they "needed" continuing education tended to have high ANSIE scores; that is, they perceived themselves as highly externally controlled. (This is difficult to interpret, except if one presumes that their "controllers" were also implying continuing education was not necessary.)

TABLE 43: ANSIE VS. TYPE OF COURSE PREFERRED

Type of Course Preferred	ANSIE SCORE 1-5	6-7	8-9	10-11	12-13	GTE 14	Total
Lecture	18 (21.7)	9 (10.1)	4 (7.3)	10 (19.6)	5 (14.7)	8 (21.1)	54 (15.4)
Recitation	23 (27.8)	30 (33.8)	21 (38.2)	17 (33.4)	9 (26.5)	10 (26.3)	110 (31.5)
Seminar	16 (19.3)	27 (30.3)	21 (38.2)	9 (17.6)	8 (23.5)	5 (13.2)	86 (24.6)
Lab	16 (19.3)	18 (20.2)	8 (14.5)	11 (21.6)	9 (26.5)	12 (31.5)	74 (21.1)
Tutorial	6 (5.1)	2 (2.2)	1 (1.8)	4 (7.8)	3 (8.8)	2 (5.3)	18 (5.1)
Correspondence	4 (4.8)	3 (3.4)	0 (0.0)	0 (0.0)	0 (0.0)	1 (2.6)	8 (2.3)
Total	83 (100.0)	89 (100.0)	55 (100.0)	51 (100.0)	34 (100.0)	38 (100.0)	350 (100.0)

Significance Level: .0227

TABLE 44: ANSIE VS. ESCAPE MOTIVATION

Escape Motivation	ANSIE SCORE 1-5	6-7	8-9	10-11	12-13	GTE 14	Total
Yes	19 (23.5)	19 (22.7)	18 (35.3)	16 (33.3)	12 (37.5)	16 (42.1)	100 (30.0)
No	62 (76.5)	64 (77.1)	33 (64.7)	32 (66.7)	20 (62.5)	22 (57.9)	233 (70.0)
Total	81 (100.0)	83 (100.0)	51 (100.0)	48 (100.0)	32 (100.0)	38 (100.0)	333 (100.0)

Significance Level: .0117

TABLE 45: ANSIE VS. KNOWLEDGE REASON APPLIES

Knowledge Reason	ANSIE SCORE 1-5	6-7	8-9	10-11	12-13	GTE 14	Total
Yes	72 (86.7)	75 (85.2)	38 (66.7)	47 (95.9)	22 (68.8)	29 (76.3)	283 (81.6)
No	11 (13.3)	13 (14.8)	19 (33.3)	2 (4.1)	10 (31.2)	9 (23.7)	64 (18.4)
Total	83 (100.0)	88 (100.0)	57 (100.0)	49 (100.0)	32 (100.0)	38 (100.0)	347 (100.0)

Significance Level: .0021

TABLE 46: ANSIE VS. COST BLOCK CRITICAL

Cost Block Critical	ANSIE SCORE 1-5	6-7	8-9	10-11	12-13	GTE 14	Total
Yes	28 (93.3)	22 (56.4)	19 (79.2)	16 (64.0)	8 (66.7)	9 (52.9)	102 (69.4)
No	2 (6.7)	17 (43.6)	5 (20.8)	9 (36.0)	4 (33.3)	8 (47.1)	45 (30.6)
Total	30 (100.0)	39 (100.0)	24 (100.0)	25 (100.0)	12 (100.0)	17 (100.0)	147 (100.0)

Significance Level: .0331

TABLE 47: ANSIE VS. QUALITY BLOCK

Quality Block	ANSIE SCORE 1-5	6-7	8-9	10-11	12-13	GTE-14	Total
Yes	14 (23.8)	35 (41.2)	27 (49.1)	22 (44.9)	9 (29.0)	9 (25.0)	121 (36.0)
No	61 (76.2)	50 (58.8)	28 (50.9)	27 (55.1)	22 (71.0)	27 (75.0)	215 (64.0)
Total	80 (100.0)	85 (100.0)	55 (100.0)	49 (100.0)	31 (100.0)	36 (100.0)	336 (100.0)

Significance Level: .0263

TABLE 48: ANSIE VERSUS DON'T NEED BLOCK

Don't Need Block	ANSIE SCORE						
	1-5	6-7	8-9	10-11	12-13	GTE-14	Total
Yes	6 (7.4)	9 (10.7)	3 (5.5)	8 (17.0)	1 (3.1)	9 (25.0)	36 (10.7)
No	75 (92.6)	78 (89.7)	52 (94.5)	39 (83.0)	31 (96.9)	27 (75.0)	302 (89.3)
Total	81 (100.0)	87 (100.0)	55 (100.0)	47 (100.0)	32 (100.0)	36 (100.0)	338 (100.0)

Significance Level: .0177

3.2.3 INTERACTIONS WITH NUMBER OF COURSES TAKEN

In Tables 49 to 51 we show the interaction of "Number of Courses Taken" with motivational variables. Three other interactions with slightly higher significance levels from Table 57 are also discussed below.

- External requirements as a motivation for taking continuing education courses were more significant for those who took fewer courses. Alternatively, those who took more courses were not motivated by requirements.

- Time as a limiting factor in continuing education was important and even critical to those who took fewer courses. (The implications for release time to pursue education seem obvious.)

- Certain other interactions were also important, although their significance level was between .05 and .10. They are reported in Table 57. Number of continuing education courses taken goes down with age. Number of continuing education courses taken is less for mechanical engineers and greater for chemical engineers and life scientists compared to other engineers and scientists. Those who found quality a critical inhibitor were likely to take fewer courses.

TABLE 49: NUMBER OF COURSES TAKEN VS REQUIREMENTS MOTIVATION

Requirements Motivation	Number of Courses Taken				
	1	2	3-5	5-8	Total
Yes	51 (75.0)	47 (70.1)	48 (60.8)	10 (40.0)	156 (65.3)
No	17 (25.0)	20 (29.9)	31 (39.2)	15 (60.0)	83 (34.7)
Total	68 (100.0)	67 (100.0)	79 (100.0)	25 (100.0)	239 (100.0)

Significance Level: .0102

TABLE 50: NUMBER OF COURSES TAKEN VS. TIME BLOCK APPLIES

Time Block Applies	Number of Courses Taken				
	1	2	3-5	6-8	Total
Yes	51 (75.0)	54 (78.3)	46 (59.0)	11 (42.3)	162 (67.2)
No	17 (25.0)	15 (21.7)	32 (41.0)	15 (57.7)	79 (32.8)
Total	68 (100.0)	69 (100.0)	78 (100.0)	26 (100.0)	241 (100.0)

Significance Level: .0015

TABLE 51: NUMBER OF COURSES TAKEN VS. TIME BLOCK CRITICAL

Time Block Critical	Number of Courses Taken				
	1	2	3-5	5-8	Total
Yes	49 (92.5)	40 (76.9)	36 (73.5)	7 (63.6)	132 (80.0)
No	4 (7.5)	12 (23.1)	13 (26.5)	4 (36.4)	33 (20.0)
Total	53 (100.0)	52 (100.0)	49 (100.0)	11 (100.0)	165 (100.0)

Significance Level: .0352

3.2.4 INTERACTIONS WITH ORGANIZATION, SPONSORSHIP, AND TYPE OF COURSE

In Tables 52 to 56 interactions with the perceived degree of organization of the course, sponsorship and type of course are presented. They are highlighted below:

- Colleges and Universities are perceived as offering less organized courses than employers and other sponsors.
- Courses sponsored by colleges and universities are also recommended less than courses sponsored by employers and others.
- A similar effect, though less statistically significant, is reported in Table 57. Respondents perceive that they learn less in University sponsored courses than in those sponsored by employers or others.
- Among those courses that are recommended, lecture classes are perceived as less organized than recitations and seminars (strangely enough):
- This same effect is repeated when respondents recommend taking another course with the instructors. (That is, lectures were still perceived as less organized, in the recommended classes.) Whether organization is a pseudo-variable for no interaction is hard to determine, but the results, as they stand, make one question why only in more successful classes does this effect show up.

- Finally, respondents report that lectures are used more for math and science courses and that seminars are used more for social science, English and fine arts courses and that recitations are used more for math and business courses.

TABLE 52: ORGANIZATION OF COURSE VS. SPONSORSHIP

Sponsorship	Organization of Course: Far Less Than Avg.	Less Than Average	Average	More Than Average	Far More Than Avg.	Total
College or University	9 (75.0)	17 (63.0)	37 (53.7)	25 (37.3)	7 (43.7)	95 (49.8)
Employer	3 (25.0)	3 (11.1)	16 (23.2)	14 (20.9)	6 (37.5)	42 (22.0)
Association	0 (0.0)	3 (11.1)	15 (21.7)	17 (25.4)	1 (6.3)	36 (18.8)
Other	0 (0.0)	4 (14.8)	1 (1.4)	11 (16.4)	2 (12.5)	18 (9.4)
Total	12 (100.0)	27 (100.0)	69 (100.0)	67 (100.0)	16 (100.0)	191 (100.0)

Significance Level: .0159

TABLE 53: RECOMMEND COURSE VS. SPONSORSHIP

Sponsorship	Recommend Course: Yes	No	Total
College or University	62 (43.4)	30 (69.8)	92 (49.5)
Employer	37 (25.8)	4 (9.3)	41 (22.0)
Association	28 (19.6)	8 (18.6)	36 (19.4)
Other	16 (11.2)	1 (2.3)	17 (9.1)
Total	143 (100.0)	43 (100.0)	186 (100.0)

Significance Level: .0087

TABLE 54: ORGANIZATION OF COURSE VS. TYPE OF COURSE WHEN RESPONDENT RECOMMENDED COURSE

Type	Organization of Course: Far Less Than Avg.	Less Than Average	Average	More Than Average	Far More Than Avg.	Total
Lecture	1 (33.3)	4 (44.5)	20 (37.7)	16 (25.4)	3 (20.0)	44 (30.7)
Recitation	1 (33.3)	1 (11.1)	19 (35.8)	24 (38.1)	5 (33.3)	50 (35.0)
Seminar	0 (0.0)	1 (11.1)	13 (24.5)	15 (23.8)	3 (20.0)	32 (22.4)
Lab	0 (0.0)	3 (33.3)	1 (1.9)	5 (7.9)	2 (13.3)	11 (7.7)
Correspondence & Other	1 (33.3)	0 (0.0)	0 (0.0)	3 (4.8)	2 (13.3)	6 (4.2)
Total	3 (100.0)	9 (100.0)	53 (100.0)	63 (100.0)	15 (100.0)	143 (100.0)

Significance Level: .0342

TABLE 55: ORGANIZATION OF COURSE VS. TYPE OF COURSE
WHEN RESPONDENT WOULD TAKE ANOTHER COURSE WITH INSTRUCTOR

Type	Organization of Course: Far Less Than Avg.	Less Than Average	Average	More Than Average	Far More Than Avg.	Total
Lecture	3 (100.0)	2 (28.6)	19 (44.2)	14 (24.6)	3 (27.3)	41 (33.9)
Recitation	0 (0.0)	0 (0.0)	14 (32.6)	22 (38.5)	4 (36.3)	40 (33.1)
Seminar	0 (0.0)	2 (28.6)	9 (20.9)	14 (24.6)	1 (9.1)	26 (21.5)
Lab	0 (0.0)	3 (42.8)	1 (2.3)	5 (8.8)	2 (18.2)	11 (9.1)
Correspondence or Other	0 (0.0)	0 (0.0)	0 (0.0)	2 (3.5)	1 (9.1)	3 (2.4)
Total	3 (100.0)	7 (100.0)	43 (100.0)	57 (100.0)	11 (100.0)	121 (100.0)

Significance Level: .0115

TABLE 56: SUBJECT OF COURSE VS TYPE OF COURSE

Type of Course	Subject of Course: Math	Phys., Life Or Env. Sci.	Soc. Sci.	Bus.	Eng.	Fine Arts & Other	
Lecture	27 (50.9)	27 (64.3	2 (50.0)	13 (27.7)	17 (28.8)	8 (20.5)	94 (38.6)
Recitation	21 (39.6)	9 (21.4)	0 (0.0)	25 (53.2)	14 (23.7)	11 (28.2)	80 (32.8)
Seminar	3 (5.7)	4 (9.5)	2 (50.0)	9 (19.1)	22 (37.3)	14 (35.9)	54 (22.1)
Lab, Tutorial, Correspondence & Other	2 (3.8)	2 (4.8)	0 (0.0)	0 (0.0)	6 (10.2)	6 (15.4)	16 (6.5)
Total	53 (100.0)	42 (100.0)	4 (100.0)	47 (100.0)	59 (100.0)	39 (100.0)	244 (100.0)

Significance Level: .0012

TABLE 57: OTHER EFFECTS (WITH LEVELS OF SIGNIFICANCE BETWEEN .05 & .10)

Variables	Sig. Level	Direction of Effect
Number of Courses Taken vs. Age	.0627	Older take fewer courses
Number of Courses Taken vs. Special Field	.0558	Chem., Eng., Life Sci., More courses; Mech. Eng. Less courses than average.
Number of Courses Taken vs. Quality Block Critical	.0910	Quality less critical to those who take more courses.
Sponsor vs. Amount Learned	.0925	More learned in employer sponsored course than college or university sponsored course.
GEFT vs. Interaction With Students	.0905	Low GEFT; not enough interaction.
GEFT vs. Recommend Course (for seminars)	.0851	High GEFT; don't recommend seminar.

3.3 SUMMARY AND IMPLICATIONS OF FINDINGS

3.3.1 KEY FINDINGS

In general the results support the underlying hypothesis that motivated this study, namely that there are important interactions between cognitive style, motivation to pursue continuing education and educational outcomes. Further, the data provide insights into independent issues having to do with cognitive style, motivation and inhibitors to continuing education, and the structure of continuing education as it affects educational outcomes.

- The earlier results of Samers & Whitcup are confirmed with respect to the cognitive styles of engineers and scientists. They have higher scores than the general population (a score of 14 on the Group Embedded Figures Test), suggesting they are indeed more field independent than the general population. This tends to confirm the characteristics thought to be associated with field independent personality (i.e. more analytical and less social).

- The hypothesis that field independence would interact with educational structure variables to affect outcomes was again supported. We found that there is indeed a need for more interaction among field dependent personalities and that they like non-lecture classes better. We also found lack of tolerance for seminars among highly field independent.

- With respect to motivation to participate in continuing education, "advancement" and "knowledge" are more important than "satisfying requirements" or "diversion" as motivators. The major blocks to continuing education are "time" and the availability of courses.

- With respect to the structure of education, it is clear that recitations and seminars are preferred over lectures and other non-interactive/learning experiences (even with a generally highly field independent population).

- University courses are regarded as poorer than those sponsored by employers and associations.

- Although over two-thirds of the respondents would recommend the courses they took, fully 30% would not, suggesting considerable dissatisfaction with the available continuing education system.

3.3.2 IMPLICATIONS OF THE FINDINGS

- First, from a pure, methodological point of view, we would recommend that the Group Embedded Figures Test should be rescaled. Whitcup suggested that independent researchers might want to shorten the time allowable for the test; however, this makes results across studies non-comparable. In highly field independent populations (such as scientists and engineers) the upper level of the test truncates (there are too many maximum scores). We believe that the test needs to be rescaled with either more problems or shorter time on a universal standardized basis.

- A second methodological issue relates to the ANSIE locus of control scale. We changed to ANSIE from a Rotter scale because we obtained very few important interactions of educational outcomes with Rotter. While ANSIE did show some significant results, none were particularly important. We did find our population similar to those previously tested by ANSIE. However, a number of times we received unsolicited comments about the wording of certain items on the ANSIE test not really being appropriate to adults. This test was converted by Nowicki and Strickland from a Locus of Control Scale originally designed for children and the conversion, in our opinion, is not entirely satisfactory.

- The implications for Continuing Education policy are, however, far more interesting. We believe it is becoming increasingly evident as additional research piles up that cognitive styles play an important role in educational outcomes. Thus, it becomes increasingly important for individuals to become more aware of their

cognitive styles and to incorporate cognitive style as one of the criteria by which they select a course. To the extent that the Foundation, educators and employers make employees/students more aware of this, they can help to improve the quality and acceptability of continuing educational experiences.

- With respect to structural implications, we see it also appropriate to educators to begin to recognize that the lecture is an archaic device, appropriate to the medieval period -- pre movable type. Comprehension of oral material without interaction is exceedingly low compared to written material and, more importantly, it may be frustrating and very limiting to those who need interaction in order to learn.

- Finally, we wonder why continuing education students find such a large fraction of their continuing education experiences so poor and why they find their university and college-sponsored continuing education experiences even poorer on the average. If we believe that updating is critical to the continuing performance of scientists and engineers, then the continuing education system must come under detailed scrutiny to attempt to identify how it can be improved.

3.3.3 FURTHER RESEARCH

- At this point we believe that some improvements in Continuing Education could be made by simply a priori screening of students and the teaching styles of instructors, with an attempt at appropriate pre-selection, incorporating cognitive style as one of the criteria for selection. We believe that this is a testable hypothesis that could be incorporated in a continuing education system or program which was large enough to allow reasonable choices by students, as well as to have a control group. We believe that this should be an appropriate step in the Foundation's research efforts and one more concrete way of showing the importance of cognitive style, with the ultimate objective of disseminating this idea so that it becomes more readily acceptable and is indeed implemented on a practical basis.

APPENDIX I: DISCUSSION OF INSTRUMENTS

A. GROUP EMBEDDED FIGURES TEST

The Group Embedded Figures Test (GEFT) is a special version of the Embedded Figures Test (EFT) developed by Philip K. Oltman, Evelyn Raskin and Henry A. Witkin for use in large-scale testing for field-dependence-independence.

The GEFT involves eighteen figures, seventeen of which are taken from the EFT. The GEFT shows high correlation (validity) with previous tests of Field-dependence-independence (.63 to .82 for individual EFT) and high split sample reliability (.82). The tests have received wide usage and are now commercially available. Test booklets and an excellent manual can be obtained from the Consulting Psychologists Press, Inc., 577 College Avenue, Palo Alto, California 94306.[1]

B. ADULT NOWICKI-STRICKLAND INTERNAL-EXTERNAL LOCUS OF CONTROL SCALE

The Adult Nowicki-Strickland Internal-External (ANSIE) Locus of Control Scale was developed in an effort to overcome some of the shortcomings of existent locus of control scales.

According to the authors, although the Rotter Scale is the most "popular" scale for measuring locus of control in adults (Samers and Whitcup used this scale in previous research for NSF), it has been criticized for its relationship to social desirability, confoundings of different types of locus of control and difficulty in reading.

The ANSIE scale uses forty items and is based on the Nowicki-Strickland Internal-External Control Scale for Children. The forty items are designed for a fifth-grade reading level. Nowicki and Duke report split-half reliabilities from .74 to .86, and descriminative construct validity independent of social desirability and intelligence.[2]

A complete report on the validity of the scale, including the instrument and detailed data on various studies (some of which were presented in Section 3) and correlations with existing personality and intelligence measures is available from Stephen Nowicki, Jr., Department of Psychology, Emory University, Atlanta, Georgia 30322.

C. CONTINUING EDUCATION ASSESSMENT

The instrument which follows this discussion was specifically developed for this study. It is primarily designed to capture two types of data: (1) Demographic data, and (2) Continuing Education experiences. The demographic questions and part of the continuing education descriptive questions are factual and relatively straightforward.

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1. Whitkin, H.A. et al., A Manual for the Embedded Figures Test, Consulting Psychologists Press, Palo Alto, 1971.

2. Nowicki, S., Jr., and Duke, M.P., "A Locus of Control Scale for Noncollege As Well As College Adults, Journal of Personality Assessment, 1973.

Subjective assessments of educational outcome variables (e.g., Would student recommend course?) are handled by a five-part "Likert" scale. Questions of motivation and inhibitors or blocks to continuing education draw on Boshier's Educational Participation Scale for the classification and description of variables. Respondents were first asked to indicate yes or no as to whether the motivation or block was applicable and then to indicate whether it was critical. This is a fairly standard technique of repetition to assess importance. Both the Likert and the two-part scale lead to significant results, most of which were expected or supportable on theoretic grounds; however, no split group reliability tests were executed for this instrument. The instrument follows.

CONTINUING EDUCATION ASSESSMENT I.D. # _____

1. Occupation: [Check the appropriate answer)

a. Identify the primary work activity that most nearly represents what you do in your occupation:

Basic Research	___	Applied Research or Development	___
Management of R&D	___	Production Engineering	___
Management & Administration	___	Consulting	___
Customer Service	___	Sales	___
Other Activities	___		

b. Identify the primary field that you work in:

Mathematical Science	___	Mechanical Engineering	___
Physical Science	___	Civil Engineering	___
Computer Science	___	Electrical Engineering	___
Life Science	___	Chemical Engineering	___
Environmental Science	___	Industrial Engineering	___
Social Science	___	Aeronautical Engineering	___
Other Science	___	Other Engineering	___
None of the Above	___	(Specify) _____	___

2. Do you supervise any other professional personnel? Yes ___ No ___

3. Age: 20 to 29 ___ 30 to 39 ___ 40 to 49 ___ 50 to 59 ___ 60 or over ___

4. Sex: Male ___ Female ___

5. Check the category that applies to you:

White (other than Hispanic) ___ Black (other than Hispanic) ___ Hispanic ___
Amerind (or Alaskan native) ___ Asian ___

6. Years worked as engineer or scientist ____

7. Highest degree: (a) None ___ Bachelor's ___ Master's ___ Doctorate ___ Other ___
(b) Year ____ (c) special field: (check below)

Mathematical Science	___	Mechanical Engineering	___
Physical Science	___	Civil Engineering	___
Computer Science	___	Electrical Engineering	___
Life Science	___	Chemical Engineering	___
Environmental Science	___	Industrial Engineering	___
Social Science	___	Aeronautical Engineering	___
Other Science	___	Other Engineering	___
Business	___	Specify _____	___
Other _____	___	_____	

8. Approximate grade average:

Undergraduate:	A+ ___	A ___	A- ___	B+ ___	B ___	B- ___	C+ ___	C ___	C- ___
Graduate:	A+ ___	A ___	A- ___	B+ ___	B ___	B- ___	C+ ___	C ___	C- ___

9. Identify the field of the college level subject you liked best:

Mathematical Science	___	Engineering	___
Physical, Life or Environmental Science	___	Fine Arts	___
Social Science	___	Language Arts	___
Business	___	Other _____	___
		_____	

10. Identify the field of the college level subject you liked least:

Mathematical Science	___	Engineering	___
Physical, Life or Environmental Science	___	Fine Arts	___
Social Science	___	Language Arts	___
Business	___	Other _____	___
		_____	

11. "Types of instruction" are listed and defined below. Write "M" to indicate the type you prefer most, and "L" to indicate the type you prefer least:

a. LECTURE - formal class almost totally instructor-centered ___
b. RECITATION - formal class, primarily instructor-centered, with class participation in questions, discussions or problem-solving ___
c. SEMINAR - small classes, informal instructor-discussion group ___
d. LABORATORY - direct participation including experiments or group learning activities with emphasis on student learning by doing ___
e. TUTORIAL - reading and one-to-one discussions with instructor ___
f. CORRESPONDENCE - no classes. Reading material and exercises exchanged by mail ___

12. Have you been employed on a full-time basis for 2 years or more? Yes ___ No ___

13. Have you taken any courses during the past 2 years? (If you have been employed for less than two years, answer for that period). Yes ___ No ___
If No, go to question 16.

14. How many courses have you taken in the past two years, excluding those still in progress? ___

15. For each course (up to 3) please provide the following information by checking the appropriate category on each line (i.e., make one entry for each line):

a. Who conducted the course?

	College or University	Employer	Association	Other (specify)
Course #1				
Course #2				
Course #3				

b. What "type" of course was it?

	Lecture	Recitation	Seminar	Lab	Tutorial	Correspondence	Other
Course #1							
Course #2							
Course #3							

c. How much interaction was there, in class, between instructor and students?

	Far less than Average	Less than Average	Average	More than Average	Far more than Average	Not Applicable
Course #1						
Course #2						
Course #3						

d. How much interaction was there, in class, between students themselves?

	Far less than Average	Less than Average	Average	More than Average	Far more than Average	Not Applicable
Course #1						
Course #2						
Course #3						

e. Did you personally have as much classroom interaction as you wanted with the instructor? With other students?

	With Instructor		With Students		
	Yes	No	Yes	No	Not Applicable
Course #1					
Course #2					
Course #3					

f. How much did you learn in the course?

	Far less than Average	Less than Average	Average	More than Average	Far more than Average
Course #1					
Course #2					
Course #3					

g. How much did you enjoy the course?

	Far less than Average	Less than Average	Average	More than Average	Far more than Average
Course #1					
Course #2					
Course #3					

h. How well organized was the course?

	Far less than Average	Less than Average	Average	More than Average	Far more than Average
Course #1					
Course #2					
Course #3					

i. Would you recommend the course to a fellow-worker?
Would you take another course from the same instructor?

	Recommend to fellow-worker		Take another course	
	Yes	No		No
Course #1				
Course #2				
Course #3				

j. Please provide the following information in the space below:
What was the duration of the course?
How many classroom hours did the course require?
Did you complete the course?
What grade, if any, did you receive?
What was the subject of the course?

	Duration (weeks)	Classroom (hours/week)	Completed (Yes or No)	Grade Received	Subject (describe)
Course #1					
Course #2					
Course #3					

16. Listed below are some possible reasons for taking courses. Consider each one in turn, and indicate by a check whether it would apply to you, if you were taking any courses. Then, for each one that applies, indicate whether you would be taking a course if you knew in advance that that particular objective would not be achieved.

	Applies		Critical	
	Yes	No	Yes	No
1. To fulfill a need for personal associations and friendships, make new friends, improve social relationships, be accepted and/or participate in group activity.				
2. To comply with instructions, suggestions, recommendations or requirements from someone else, or some authority. To meet formal requirements and/or employer policy.				
3. To improve my ability to serve, or prepare for service to, the community or mankind, and to be a more effective citizen.				
4. To gain professional advancement and/or increased job status and competence.				
5. To obtain relief from boredom or the routine of home or work. To provide contrast to the rest of my life and/or escape day-to-day responsibilities and/or frustrations.				
6. To learn and obtain knowledge for its own sake.				
7. Other (specify)				

17. Listed below are some possible "blocks" or impediments to taking courses. Consider each one in turn and indicate by a check whether it currently applies to you. Then, for each one that applies, indicate whether you would take a course if that particular impediment were removed.

	Applies		Critical	
	Yes	No	Yes	No
1. Too time-consuming or too many other commitments to make it feasible to take courses.				
2. The cost of taking or traveling to the courses is excessive.				
3. Desired courses are not offered, or are not offered at feasible locations.				
4. Available courses are of poor quality.				
5. I personally do not need or want additional courses.				

APPENDIX II: BACKGROUND FOR THE STUDY

THE MOTIVATIONAL ORIENTATIONS OF ENGINEERS IN CONTINUING EDUCATION

Educational planners have long been interested in why adults participate in continuing education. Although there has been extensive demographic and sociological characterization of participants and non-participants in continuing education, until recently there has been no systematic study of the motivational orientations of participants (versus non-participants), nor of their psychological make-up. In a seminal study, Houle (1961) developed a three-factor typology of adult learners: goal oriented, activity oriented, and learning oriented. The goal oriented adult uses continuing education as an instrumental means to achieve specific goals or ends. The activity-oriented learner participates in continuing education mainly because of the social relationships which are generally an accoutrement of the learning situation. Finally, the learning-oriented participates because he is interested in learning for learning's sake.

In the wake of Houle's work a number of researchers, not only in the United States, but also in such countries as New Zealand, Canada and Sweden, have studied varied aspects of adult learners' motivations. Many of these studies have involved the construction of an instrument to measure motivation, consisting of Likert-type questions derived from Houle's typology, depth interviews with adult learners, and personal observation on why adults participate in continuing education, and its administration to a group of adult learners. In order to identify orientations, individual scale items are typically clustered by the statistical technique of factor analysis. The three principal instruments that have been utilized are the

the Education Participation Scale (Morstain and Smart, 1974, Boshier, 1971), The Reasons for Educational Participation Scale (Burgess, 1971) and the Continuing Learning Orientation Index (Sheffield, 1964).

Boshier (1976) continued to do research and published a critical review of the literature and methodology surrounding these three scales, citing the work identified above as well as that of Grabowski (1973), who identified a new motivational factor he described as "desire to study alone".

A year later Boshier (1977) developed a model which described participants as life-chance (deficiency) or life-space (growth) oriented. These were again based on responses to the EPS. Boshier concluded it was possible to categorize participants by these motivations but it was argued that "further research concerning the social and psychological foundations of motive for participation is needed."

Darkenwald (1977) claims that most of the recent studies using the EPS scale yield remarkably similar findings. Six factors are identified: social relationship, external expectation, social welfare, professional advancement, escape/stimulation and cognitive interest. He also concludes (1) Houle's three-factor typology of the adult learner is inadequate, (2) major orientation factors are only generally valid, and (3) most people participate in adult education for mixed reasons, some related to learning and others not. He further suggests researchers and planners need to be aware of the variety and complexity of motivations underlying participation in continuing education. Darkenwald points out that engineers probably differ from the general adult public in the importance of different motivational factors.

Hammer (1977), in proposing a model of interests and needs in continuing education, focuses on "blocks to motivation." She identifies a number of works in which systematic variables (time, availability, money) are identified as blocks to motivation, and although she cites interest and needs as important, learning patterns and cognitive style are essentially ignored as they are in Boaz's (1978) work for the National Center for Educational Statistics. While that survey collected data on teaching method and reasons for taking or dropping courses, it sheds almost no light on the issue of cognitive style of earlier instructors or students and its effect on motivation. The relevant questions are not even asked, although a great deal of demographic data is developed.

Another study focusing on the negative aspects of motivation is the work of Garry (1977) in which he explores "the Relationships Among Anomia, Attitude toward Adult Education, and Non-participation in Formal Adult Education Activities." This study demonstrates that psychological characteristics can importantly impinge upon the motivation for continuing education.

The work of Snow and Farr for NSF, (1980) focuses on organizational and environmental variables as they affect motivation, but again, not on cognitive styles. Also, Levy (1979) explores usage and motivation at a more global level. In our own work, Samers and Whitcup (1979) address the impact of cognitive style in continuing education on educational outputs, but it does not deal extensively with motivation, and the focus is on alternative teaching styles.

- WHAT ARE LEARNING STYLES OR PATTERNS?

Learning styles or patterns refers to the "cognitive styles" of students or individuals in learning situations. Kogan (1971)* has defined cognitive styles as "Individual variation in modes of perceiving, remembering and thinking, or as distinctive ways of apprehending, storing, transforming and utilizing information." It is assumed that cognitive style is a relatively stable and enduring characteristic that is revealed in one's perceptual and intellectual activities in a highly consistent and pervasive way (Witkin, 1976; Witkin and Moore, 1974).

- SOME MODELS OF COGNITIVE STYLE

Messick (1970) has identified nine distinct dimensions which fall under the rubric of cognitive style: (a) field-independence versus field-dependence:analytical versus global way of perceiving; field-independence entails a tendency to experience items as discrete from their backgrounds, while field-dependence focuses on the relationship of items to their background, (b) scanning — differences in the extensiveness and intensity of attention deployment, (c) breadth of categorizing — preferences for broad inclusiveness versus narrow inclusiveness in establishing the acceptable range for specified categories, (d) conceptualizing styles — the tendency to conceive of things as having many properties as opposed to few.

Messick continues with: (e) cognitive complexity versus simplicity — individual differences in the tendency to construe the world, particularly the social world, in a multidimensional and discriminating way,

*See Appendix III for the complete citation of all works referenced in this Appendix.

(f) reflectiveness versus impulsivity — individual differences in the speed with which hypotheses are selected and information processed,* (g) leveling versus sharpening — assimilation versus discrimination in incorporation of information into memory, (h) constricted versus flexible control — individual differences in susceptibility to distraction and cognitive interference, and (i) tolerance for unrealistic experiences.

McKenney and his associates at Harvard (McKenney, 1972; McKenney and Keen, 1974) have developed a cognitive style model that hinges upon two dimensions of human information processing: information gathering and information evaluation. In information gathering individuals may be preceptive, bringing concepts to filter data and focusing on relationships between items, or receptive, that is more sensitive to the stimulus itself and focusing more on detail than on relationships. In analyzing informational inputs individuals may be systematic, approaching a problem by structuring it in terms of some methodology, or intuitive, jumping from one methodology to another and using trial-and-error methods to arrive at solutions.

Hill and his coworkers at Oakland Community College view cognitive styles as being the cartesian product of three sets of elements: symbols and meanings, cultural determinants, and modalities of inference. The first set, symbols and meanings, indicates an individual's tendency to use certain types of symbols, i.e., theoretical symbols — such as words and numbers — and qualitative symbols — which present and then represent to the individual *only* that which the symbol is.

Cultural determinants are influences which the individual brings to derive meaning from symbols (e.g. family's perceptions, associates'

*Often referred to as conceptual tempo.

perceptions, etc.). The third set indicates whether the individual thinks in terms of categories, or in terms of differences, or analyzes multiple relationships or employs all three aforementioned modes of thought. The Hill model of cognitive styles has been used extensively by colleges, high schools and elementary schools to identify the cognitive styles of students and teachers and to prescribe personalized educational approaches based upon these findings (Schall, 1976).

- IMPLICATION OF COGNITIVE STYLES FOR THE LEARNING-TEACHING PROCESS

Cognitive style has been shown in numerous and varied studies to have a significant impact upon learning behavior, teaching behavior and the student-teacher interaction. These will be discussed in turn, focusing on, for the sake of brevity, the most thoroughly researched element of cognitive style — field-dependence versus field-independence (Martens, 1975).

- COGNITIVE STYLE AND LEARNING BEHAVIOR

Since field-dependent persons' perceptions are global — that is, elements are perceived in their relationship to the field, it should not be surprising that field-dependent persons have difficulty with analytical problems that require critical elements to be taken out of context and the field reconstructed with the critical elements in a different context. Field-independent persons have no such difficulty. Further, field-dependent persons are more likely to accept the organization of material to be learned as a given (as imposed by the nature of the material itself or by someone else) rather than attempt to impose an organization of their own. When the material to be learned has no inherent structure, field-independent students learn it much better than field-dependent students. (Bruce, 1965).

Associated with field-dependent persons' attentiveness to the field

in intellectual functioning, is also greater attentiveness to the "social field"; field-dependent persons are more likely to take into account and be influenced by points of view of (significant) others and be more receptive to social cues (see, for example, the series of studies by Eagle, Fitzgibbons, and Goldberger; Nevill, 1971, Duble and Nakamura, 1972; etc.). Field-dependent persons tend to do well in subjects in which social orientation is important (e.g., the social sciences); field-independent persons excel in subjects that may be termed more "impersonal", abstract, and analytical (e.g., the physical sciences) (Witkin, 1973).

Social reinforcement (e.g. praise, censure) has greater impact on field-dependent than on field-independent students vis-a-vis the learning of classroom material (Konstadt and Forman, 1965; Fitz, 1970; Randolph, 1970; etc.). Overall, field-dependent students are better at remembering "social" material while field-independent students are better at learning "impersonal" material.

COGNITIVE STYLE AND TEACHING BEHAVIOR

The "cognitive style" of teachers has been shown to be associated with particular teaching methodologies, strategies, and with other classroom behaviors. Wu (1968) found that field-dependent teachers prefer the discussion method of teaching (in which there is greater student-teacher interaction), while field-independent teachers prefer lecturing or discovery methods. Ohnmacht (1967a, b) observed that field-independent teachers are more direct in their attempts to influence students than field-dependent teachers; also, field-dependent teachers tend toward the use of democratic (i,e. student centered) instructional methods more than field-independent teachers.

COGNITIVE STYLE AND TEACHER-STUDENT INTERACTIONS

Based upon cognitive styles, a teacher and a particular student may be either matched (e.g. field-dependent teacher and field-dependent student) or mismatched (e.g. field-independent teacher and field-dependent student). Although mismatching of student cognitive style and teaching methodology or strategy (associated with a particular teacher cognitive style) may adversely affect student learning (Tarrance and Davis, 1971), teacher behavioral adaptations can negate this effect.

Hill (1974) has developed a three-fold classification of teachers based upon modification of their teaching approach to meet the needs of students with different cognitive styles: teachers with a "predominant style" maintain a fixed educational methodology despite student differences in cognitive style; teachers who are "switchers" use the students' cognitive styles as points of departure and vary their approach so that students accomodate to the instructor's preferred teaching style; and teachers who utilize teaching styles which are geared to meet the needs of students' cognitive styles are considered to be "flexible."

Messick (1970) has pointed out advantages to both matching and mismatching of student cognitive styles and teaching styles. Intentional mismatching may benefit the student by building missing student skills (i.e., remedial mismatch) or by helping the individual become more flexible in cognitive style. Intentional matching may help the student by building on student strengths and by fostering student feelings of success and achievement through the avoidance of situations that require the use of skills that the student doesn't have. It should be noted, however, that mismatching may actually engender a negative learning atmosphere; DiStefano (1969) and James (1973), for example, found that while students and teachers

matched in cognitive style viewed one another positively, students and teachers who were mismatched viewed one another negatively.* Witkin (1976) has suggested that persons matched in cognitive style tend to get along better (i.e., have positive feelings for one another) for three reasons: because of shared foci of interest, because of shared personal characteristics, and because of similarity of communication modes, making for easier and more effective communication.

- APPLICABILITY OF COGNITIVE STYLE STUDIES TO CONTINUING EDUCATION FOR ENGINEERS

The difference in social orientation between field-dependent and field-independent persons has been previously shown to be associated with academic performance in the social sciences versus the physical sciences. This difference in orientation also plays a significant role in the selection of various occupations and in how well individuals perform in occupations: field-dependent persons gravitate towards and do well in occupations requiring social orientation (e.g. social work, teaching, retail selling, etc.), while field-independent persons opt for and excell in occupations requiring impersonal, analytic orientation (e.g. engineering, computer programming, chemistry, etc.). Although it may be thought that most — if not all — of the individuals within a given occupation share a particular field orienta-

*The same relationship has been observed in other social interaction situations; therapists and patients who are matched in cognitive style view one another positively, while those who are mismatched view one another negatively (Greene, 1972). Cognitive style differences can also affect the nature of the therapist-client contact. Witkin et al (1968) found that when patient and therapist were matched in cognitive style the number of interactions increased dramatically. Furthermore, regardless of matching, field-dependent therapists tend to intervene more than those who are more field-independent. Also, regardless of therapist cognitive style, therapists tend to intervene more with field-dependent patients. Greene (1972) also found that therapists adapt their therapeutic approach to the patient's cognitive style, providing more supportive therapy for field-dependent patients.

tion, wide variation has been found to exist between specialties within a given occupation: for example, Nussbaum (1965) found that systems engineers are more field-independent than other types of engineers, and Quinlan and Blat (1973) observed that high-achieving psychiatric nursing students are more field-dependent than high-achieving surgical nursing students.

Yet even granting that such cognitive differences do exist among individuals in a particular occupation, it may be argued that such differences are irrelevant to the continuing education of engineers. A frequently made assumption is that at the graduate school level good teaching and learning are ensured by the teacher's devotion to and knowledge of the subject matter and by the students' commitment to seek advanced training. However, this assumption is open to serious question on the basis of the significant evidence that has been amassed in regard to other areas of social interaction — for example, patient-therapist relations — that variables such as cognitive style do have a major impact upon the nature and the quality of adult social interactions. Although most of the learning and teaching style studies have involved children, a strong case can be made for their applicability to adults as well, and some of these are discussed below.

- SOME RECENT WORK ON THE IMPACT OF COGNITIVE STYLE ON LEARNING OUTCOMES OF ADULTS

The issue of whether the pairing of student and teacher cognitive styles has had some recent attention. Rains (1976) working with students at a junior college concluded "students with higher grades had learning styles more closely related to instructor teaching styles than students achieving lower grades. Brown (1978) showed that "for those learners perceiving congruency between their preferred styles and the teaching

style actually perceived achievement was greater than for those perceiving incongruency, Root and Gall (1979) similarly found that college students did better if they were assigned to teaching "treatments" which corresponded to their cognitive style.

Less striking results were achieved by Scerba (1979). Although finding no direct relationship between the educational outcomes of Community College students and the matching of their learning styles with instructional styles, certain second order effects with course content were observed and Scerba concluded teaching style was only partly important. Similarly in an experiment conducted by the American College testing program at two community colleges in Michigan, "the project results did not establish the existence of significant relationships between the use of cognitive style measures and data on educational outcomes."

In some related work Horak and Zweny (1978) showed that field dependent mathematics students "learned more" if the material was presented using an inductive rather than a deductive approach.

Finally, Thompson, in 1979, looked at educational outcome versus five measures of student cognitive style, including GEFT and ANSIE. He found only GEFT was directly related to measures of educational achievement "in contrast to previously reported research."

In summary, the evidence is beginning to "pile up" that cognitive style and cognitive style matching may have significant import on educational achievement, even at the adult level.

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